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Ways Technology Impact Cognitive Development in Early Childhood Environment

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Abstract

Dramatic changes have occurred with technology in education worldwide (Sullivan and Bers, 2016). Technology can offer new and exciting ways to get children excited about learning. The types of technology that can be used in a classroom are endless. Research has investigated a wide range of technology in classrooms, from smartboards, to robots, iPads, and tablets to magic educational toys and from computers to apps. The purpose of this capstone project was to evaluate current research to understand what technologies (interventions) can impact cognitive development in preschoolers. Knowing in what ways technology can impact cognitive development in early childhood education will give early childhood educators a better understanding of how to incorporate different types of technology into early childhood education and what outcomes early childhood educators should expect to see (Danovitch, J. H., 2019). Findings from the article by Danovitch (2019), indicate that as an early childhood educator, technology can be used to help close the gap with inequality around technology, and to help close the gap with literacy. The findings also indicated that early childhood teachers need additional training for technology and that if early childhood educators are to be successful incorporating technology into the classroom there needs to be support from other early childhood educators and administration (Danovitch, 2019). There needs to be a solution to help early childhood educators increase their confidence in the use of technology in the classrooms. Early childhood educators need accessible professional development opportunities, to improve skills and knowledge in making decisions on how to select, use, integrate and evaluate technology use in the classrooms.

Key Terms

STEM: Science, Technology, Education, and Mathematics (STEM) education is a curriculum-based program that focuses on science, technology, engineering, and mathematics (Sullivan & Bers, 2016).

Interactive (Digital) Media: Interactive media can either be digital or analog materials. These materials can include software programs, applications (apps), broadcast and streaming media, television programming, e-books, and the Internet. They are designed to facilitate active and creative use by young children and are hands on (NAEYC, 2012).

Digital Divide: Digital Divide is a term used to identify a gap in access to modern information technology, such as computers based on someone's socioeconomic status or the ethnic background (Judge, S., 2004).

Digital Equity: Digital equity is a goal of making sure all students have equal access to information and communication technology for education purposes regardless of race, gender, socioeconomic status, ethnic background, or disability (Judge, S., 2004).

Chapter One: Introduction

When working in early childhood education, educators try to find ways to get the children excited about learning new things. Science, Technology, Education, and Mathematics (STEM) education is a curriculum-based program that focuses on science, technology, engineering, and mathematics, which are taught in an interdisciplinary approach. Many times, the technology and engineering components of STEM education are either missing from curriculum or given little attention. In early childhood education the “T” of technology and the “E” of engineering are often neglected (Sullivan & Bers, 2016). Previously neglected areas, such as the “T” of technology and the “E” of engineering, are now getting significantly more attention with the release of new learning standards and best practices for integrating technology into early childhood education, (Sullivan & Bers, 2016).

Technology is here to stay, and children are being exposed to technology from as young as a few months of age. Studies have concluded that toddlers, even at the age two, can easily interact with touch screen iPad tablets. Toddlers were able to work and explore with their iPads independently and their interactions were very different than their interactions with traditional computers (Geist, 2012). Technology can be empowering for all children and can provide for fun ways to engage children in learning. Children who learn technology and continue to excel at its use will be better equipped to succeed in school and a digital workforce (NAYEC, 2012). The National Association for the Education of Young Children (NAEYC, 2012) recognized technology as an integral learning tool, in early childhood education, in promoting social, linguistic, and cognitive development. NAEYC also identified in their position statement that technology and interactive media needs to be used intentionally by early childhood educators and it needs to be developmentally appropriate practice. The question facing early childhood

educators today is not if technology should be used, but how to use technology to enhance learning and cognitive development. From birth to age eight, children's social and cognitive skills have developed quickly through exploring and learning in various environments.

Danovitch (2019) believed the exposure of technology could impact the cognitive development of children regarding memory, concentration, seeking information, and thinking. Identifying how to use technology that is developmentally appropriate that has positive impacts on cognitive development is pivotal in early childhood education (NAYEC, 2021).

Question

The question used for this capstone project was "In what ways can technology impact cognitive development in early childhood environment"? The targeted group of participants were preschool children ages three to five. The goal of this research was to understand what technologies (interventions) can impact cognitive development in preschoolers.

Research

A comprehensive literature review was completed to look at current research on the impact of technology in early childhood education, types of technology used in early childhood education and early childhood education educators' perceptions and beliefs around the use of technology. Early childhood educators develop the curriculum for their classroom and the experiences the children will have. Early childhood educators need to know what technology is developmentally appropriate for their classroom and how that technology can impact the cognitive development of the children.

Integrating technology and supporting children's experiences with technology relies heavily on early childhood education teachers. Educators' beliefs, technology skills, and perceived barriers effect how these educators integrated technology into the classrooms. The

higher the teachers' confidence the higher the integration of technology in the classroom is (Chen & Chang, 2006). The research reviewed identified that there are perceived barriers to integrating technology in the classrooms. Research showed a lack of support by peers and administration, as well as lack of education (Blackwell et al., 2014; & Inan & Lowther, 2010). Many early childhood educators felt that there was a lack of skills needed to bring technology into the classroom. Offering educational opportunities and providing support to our educators will be the key to removing some of these barriers.

Conclusion

Having an understanding and learning the types of technology that can be used in early childhood education allows educators to tap into young children's potential learnings. Knowing and understanding which types of technology have been shown to have positive outcomes on early childhood education allows educators to implement developmentally appropriate technology in different learning environments. Research showed technology can be used as a way to incorporate technology into early childhood education that is exciting and new (Sullivan & Bers, 2016).

Chapter Two: Literature Review

A total of 17 articles were reviewed for this literature review. The literature reviewed focused on some main themes, such as the types of technology used, families and early childhood technology, culture and diversity with technology and the educator's attitude, perceptions, and barriers to implementing technology in the classroom. Research reviewed demonstrated positive outcomes of using technology to assist children in learning alongside of teacher-led instruction (Babell & Pedulla, 2015; Geist, 2012; Sullivan & Bers, 2016; Travers, Higgins, Pierce, Boone, Miller, & Tandy, 2011; Van Daal & Reitsma, 2000). Many times, parents are not always aware of their influence over children, as noted in the research by Pullman et al., 2011, and by Gutnick et al., 2011. Parents are a key to children learning technology and research has demonstrated that a parent's guidance can improve you children's learnings which has been shown to advance their language development (Gutnick et al., 2011). The literature reviewed also showed that there are barriers to implementing technology in early childhood education. The research demonstrated that what educators need most is support and educational opportunities from administration and peers (Blackwell, Lauricella, Wartella, 2014; Chen & Chang, 2006; Inan & Lowther, 2010; Nikolopoulou & Gialamas. 2013).

Types of Technology

Sullivan & Bers (2016) provided information saying that pre-kindergarten children can master early concepts around programming a robot and that children as young as seven years old can actually program a robot using conditional statements. The purpose of this study was to show how robotics and computer programming can be introduced in early childhood education. The study collected data from children in pre-kindergarten through second grade after a completion of an eight-week robotics course. The study was made up of 60 participants: "N = 15 pre-

kindergarteners, N = 18 kindergarteners, N = 16 first graders, N = 11 second graders” (Sullivan & Bers, 2016). There was a total of seven lessons which included a final project. Once the program was completed the children were given two different assessments. “The Robot Parts task was used to determine each child’s robotics knowledge and the Solve-It assessment was used to measure each child’s programming knowledge” (Sullivan and Bers, 2016). The average score on the Solve It post-tests were very high which indicated that the children had a good understanding of the functions of the robotics. The kindergartens did not score as well on the programming test as the older children. The study showed using robotics kits for young learners can be a useful educational tool in early childhood that offers teachers new and exciting ways to bring the “T” and “E” back into early childhood STEM (Science, Technology, Education and Mathematics) education. This research study has shown that technology can get introduced to children at a much younger age.

Limitations of this study were identified as the length of the study being only eight weeks and the time allotment was too short. With such a short timeline the pre-kindergarteners were not able to learn more advanced programming concepts, which limited their success to completing only two Solve-It tasks (Sullivan and Bers, 2016). The study is relevant to the capstone question because it shows how technology can be a tool used in early childhood education. As educators in the early childhood field, finding ways for children to use technology in a safe and skillful way will continue to be important and robotics offers on viable option.

Bebell & Pedulla (2015) looked at another type of technology, that of iPads. The researchers looked at the impacts of 1:1 iPads on kindergarten student’s math achievement and English Language Arts. This study was a quantitative research study and used a pre/post randomized control trial. A total of 16 Kindergarten classrooms participated in the study. The

researchers randomly assigned 8 of the 16 Kindergarten classes to use iPads as a learning tool and the remaining 8 classes served as the control group and had no additional resources. The study took place for nine weeks of the beginning of the school year, with a total of 266 Kindergarten students, of which 129 were in study group and 137 were in the control group. This study used an experimental design. The researchers did the experiment around the kindergarten assessment schedule already in place. The timing of this study allowed the researcher to use the traditional ELA (English language arts) assessment schedule to provide the pre and post student achievement measures (Bebell, & Pedulla, 2015). The outcome measures were measured by pre/post CPAA (Children's Progress Academic Assessment), the Rigby Reading Assessment, and OSELA (Observation Survey of Early Literacy Achievement) assessments. According to the research the CPAA is commonly used throughout the United States for assessment of early childhood learning (Bebell, & Pedulla, 2015). Research has also shown that the Observation Survey of Early Literacy Achievement (OSELA) assessment is reliable and shows valid measurements of early childhood literacy development (Bebell, & Pedulla, 2015).

The kindergarten students were given iPads for the first twelve weeks of class. The researchers then collected pre and post assessment scores from the literacy assessments stated above. The pre assessment scores of both groups showed little difference in the CPAA and Rigby assessments. The post iPad scores for the CPAA and Rigby assessments also showed relatively little difference in the scores. Similar findings were shown with the OSELA assessment pre and post scores for both groups. Kindergarten students in both groups showed performance gain in literacy but there were no statistically significant differences. SPSS (Statistical Package for Social Sciences) statistical software was used to analyze the data.

An important limitation to note in the study by Bebell & Pedulla (2015) was the nine-week timeline. This may have been too short to really expect to see gains that differ amongst the two groups. The researchers also stated that the study only provided limited evidence favoring iPad usage. This could again be attributed to the short timeline of nine weeks. This study relates to the research topic because it specifically looked at a new form of technology, that being iPads and how the use of iPads impacted Kindergarten's math achievement and English Language arts. Kindergarteners today are very comfortable using iPads, so understanding the impact iPads can have on cognitive development is important to this type of research.

Geist (2012) looked at yet another type of technology that can be used in the early childhood classroom, that being tablets. This study looked at two-year olds interacting with tablet-based touch screen technology. Researchers in this study used observations of toddlers (two- years old) use and interaction with touch screen tablets (iPads). This study was a qualitative study that used observations and was comprised of two parts. As with the previous study there were two parts. The first part was that of the researcher observing the researcher's own child ages of 24-31 months. The second part of the study involved 20 toddlers at a university laboratory school, from two classrooms.

Geist (2012) found that the data and results between the two studies were very consistent. As with most qualitative research, the researcher put the results into buckets or themes, and identified that there were three. The first theme was that "two-year-old children can easily and naturally interact with the touch screen interface in a way that is different from a traditional computer" (Geist, 2012). According to the research, most of the children needed little interaction from the teachers. The ones who did need assistance needed no more than two sessions of help (Geist, 2012). A second theme that was identified was that the "children's ability to work

and explore independently with the device is much greater than with traditional computers” (Geist, 2012). The iPad devices resembled how children play with toys and were intuitive for them, such as when children play with blocks or a sensory table (Geist, 2012). The toddlers were able to open videos and even Netflix without any assistance (Geist, 2012). The last theme showed that the devices used in this study enhanced the teacher’s ability to conduct projects with the children that would not have worked on a traditional computer. Teachers reported that using the iPads allowed them to make the projects concrete and related the projects to experiences, such as video presentations of the topic being studied (Geist, 2012).

This study concluded that toddlers, even at the age 2, can easily interact with touch screen iPad tablets. The teachers needed to provide very little instruction to the toddlers. The toddlers in this study were able to work and explore with their iPads independently and their interactions were very different than their interactions with traditional computers (Geist, 2012). In the conclusion of this study, this researcher felt that these devices could be a meaningful addition to toddler and preschool classrooms (Geist, 2012).

There were no limitations presented in this study, however, there potentially was one limitation was that of the researcher. Geist himself studied his own child in part one. In part two of the study, he collected the data along with the teachers, and because there were different experts collecting data between the two parts, this could lead to some inconsistencies.

Van Daal & Reitsma (2000) looked at the use of computers to assist with learning reading and spelling skills in kindergarten children. The researchers conducted two small-scale pilot studies. The purpose of the first study was to understand if kindergarten children can develop reading and spelling skills through computer-assisted use. There were 21 kindergarten children in this study. Nine of these children were randomly assigned to the experimental group

and the remaining 13 made up the control group. The children in this control group were not given any access to computers throughout the study. Children in the experimental group were pre-tested for reading readiness.

The study took place in two K2 kindergarten classrooms in the Netherlands. There were 21 children who participated in the study. Nine of the children were in the experimental group and the remaining 13 were in the control group. The two classrooms were given two computers for a four-month period during the study. Teachers only turned on the computer and made sure that children in the experimental group were given time each day to practice. A researcher came in once a week and looked at the practice results and made any adjustments to tasks and assigned more difficult tasks as the children progressed through the assignments. At the end, all children were given three post-tests that looked at naming letters, a standardized test for word recognition and a standardized word reading test.

The results showed there was a large variation in the time it took to complete the tasks. The quickest was 94 minutes while the longest was 5 hours and 43 minutes (Van Daal & Reitsma, 2000). The children made very little mistakes in completing the tasks. When the researcher compared the pre and post test results of the experimental group it was found that “there were significant gains in letter knowledge but not in concepts about reading and writing” (Van Daal & Reitsma, 2000). The researchers concluded that the experimental group improved on letter naming and the students in the experimental group, who practiced with the computer, were able to reach more words and nonwords than students in the control group (Van Daal & Reitsma, 2000).

Another study analyzed use of computer-based spelling practice with children who had a reading disability and with low levels of motivation. The participants of this study were three

girls and eleven boys from multiple special education classrooms. The average age was 10 years 7 months. The students in this study were given a pre and post standardized spelling test. During the study, the group of participants used computer-assisted spelling exercises. The students used the computer for “5 minutes a day, as least three times a week for about half a year” (Van Daal & Reitsma, 2000). The researcher found that the average number of words correctly spelled pre-computer-assisted training was 58.0 and post was 74.3 (Van Daal & Reitsma, 2000). This improvement was statistically significant with a $p > 0.001$ (Van Daal & Reitsma, 2000). During the study there were two times the researcher observed the children. An analysis of their observations showed that the experimental group students demonstrated more positive behaviors while working with the computer than the control group students who received classroom instruction (Van Daal & Reitsma, 2000).

There were no limitations identified for either of the two studies by the researchers. A limitation though might be with the limited amount of time of the study, the control group did not do a pre-test. While the post test showed significant difference between the two groups, there is not comparison for the baseline between the experimental group and control group.

This study related to the question because it studied kindergarten children and the effects of computer-assisted program in letter recognition and reading. This age group is the same age group that the capstone is focusing on and understanding how technology can impact such a foundational concept of letter recognition is extremely important.

The last article that looked at types of technology is an article done by Travers, et al., (2011) which looked at technology with young children with autism. Seventeen students attending preschool programs specifically for students with autism were selected for this study. Ages of the students were three to six years of age. The purpose of this study was to compare

teacher-led instruction to computer-assisted instruction in relation to alphabet skills. The teacher-led instruction used alphabet books to instruct the children compared to computer assisted instruction to teach the same alphabet skills. Throughout the course of the study, the students were administered the portion of the Brigance Inventory of Educational Development-II (BIED-II) designed to assess alphabet recognition skills a total of five times (Travers, J. et. al, 2011). The times of administration were (a) prior to receiving any intervention, (b) upon completion of the first four-week intervention, (c) after a two-week maintenance period without instruction, (d) at the completion the second four-week intervention, and (e) after a second two-week maintenance period (Travers, J. et. al, 2011). Analysis of the data showed that there was a significant difference between pre and post test scores for both computer-assisted instruction and teacher-led instruction with the student's ability to recognize letters of the alphabet. The statistical difference of pretest to posttest with both types of instruction was $p > .001$ (Travers, et al., 2011). While both types of instruction showed significant improvement, the findings did not show significant differences between the two types of instruction (Travers, J. et. al, 2011).

There were limitations identified in this research study by the researchers. The participant size of this study was small, so the ability for the researcher to generalize their results is not possible. The ability to generalize their results was also limited because of the short length of time the study took place. Finally, the classroom of the participants were picked based on convenience which also leads to a lack of generalization. This research looked at kindergarten children and explores the use of computer-assisted technology. This study specifically looked at children with autism, but additional research could easily be repeated with other early childhood children without autism.

Families and Early Childhood Technology

Technology in early childhood education does not just apply to the classroom setting. Children are using technology earlier and earlier and a lot of that is occurring at home. Understanding how children are using technology at home and how parents are supporting the use of technology at home will help to understand how technology can benefit early childhood education and even cognitive development. The next articles looked at technology at home, the uses, and parents. A study by Plowman et al., (2008) looked at the different types of technology used at home, the role of the parents and other siblings and how the use of this technology was supported. This study used a survey that was sent to parents, case studies and interviews of professional educators were also completed. The research focused on three and four-year-old preschool children, from 10 different preschools in central Scotland. There were 800 surveys sent out to the parents of three and four-year-old preschoolers and 346 were returned which is a 43% return rate. All the parents who returned the survey were asked to participate in the case studies, of which 74 volunteered. The final group of parents (24), were selected based on socioeconomic status, high or low use of technologies and gender of child (Plowman et al., 2008). The case studies consisted of five home visits with the family, both parents and children. There was not a significant difference on access and type of technology based on socioeconomic status. “Most of our survey respondents’ children were living in households where there was access to a mobile phone (98%) and a television with interactive features (75%). Internet access was unequally distributed, however: while over four fifths (82%) of the more advantaged families had access, just over half (56%) of the less advantaged respondents did so (Plowman et al., 2008)”. Parents in this study had some concerns that childhood was being transformed by technology, that because of media attention, children’s social, emotional, and cognitive

development was threatened by technology. The researchers also discovered in this study, that $\frac{3}{4}$ of the parents who responded to the survey felt that they had little to do with children learning new technologies. The parents were doing very little tutoring when it came to using technology and felt that the children were just able to pick it up. Based on this study, it appears that three and four-year-old children are able to “pick-up” technologies and become competent, but it was more by observations than by actual teaching coming from parents or other family members.

This article applies to the research topic, because if early aged children are going to be using technology to enhance their education, there will need to be parental teaching as well. Parents and family members play a key role in a child’s educational learnings. While parents in this study did not feel they were teaching their children about technology or its use, the parents were modeling its use for the children (Plowman et al., 2008). Children were able to watch, copy and imitate what their parents were using. This is a type of scaffolding. Understanding parents’ knowledge and comfort with technology is important, as this is not something children can just pick up.

In another study by Plowman et al., (2011) the researchers looked more closely at preschool children’s learning and technology at home. The researchers focused on what technologies children encounter at home, how family practices support technology and what children are learning from these encounters with technology. For this study fourteen families from central Scotland were recruited who had a three-year- old child at the beginning of the study. There were nine rounds of data collection performed in this study. The main exposure to technology was a television, followed by a gaming console such as Xbox or Nintendo, and then a mobile phone (Plowman et al., 2011). The study also showed children played games on computer as well as mobile phone. Computers and mobile phone were used less frequently

because the children need the parents to help them with the devices and set up the device.

Gaming consoles were also a challenge for these children because the gaming consoles often required fine motor skills that not all three-year-olds have (Plowman et al., 2011). Parental perceptions of technology can be greatly varied as was found in this study. For example, one mother was a proponent of technology, the family had a lot of technology and the three-year old had his own V-tech computer (Plowman et al., 2011). This mother was very proud that her son had learned his alphabet and was now learning his numbers through his computer. On the other hand, some parents are afraid of technology or are hesitant on what the benefits are. One parent in this study felt it was more important for her child to be with other people to develop social skills rather than sit in front of a computer (Plowman et al., 2011). This parent also taught her three-year-old the alphabet and numbers using flashcards. What was interesting to note from this study was that the parent who was hesitant to let her child spend more time with technology than the parent who was a proponent. It is important to note that socioeconomic status or ownership of technology does not predict technology practices at home. There are many factors that can play into use of technology at home, including the child themselves.

A report by Gutnick et al., (2011) reviewed seven different research studies on young children and their use of media. It showed that television was still the most prevalent type of technology used. Most children under the age of 4 watch television with their parents. Parents are the most important influence on their children and use of technology. Whether watching a show on TV or reading an e-book, parents can help explain information that children may not understand (Gutnick et al., 2011). According to Gutnick et al., (2011) a parent's guidance can improve you children's learnings which has been shown to advance their language development. Parents are not always aware of their influence over children, as noted in the research by

Pullman et al., 2011, and by Gutnick et al., 2011. The researchers noted that the simplest way to bring a healthier balance to a child's media practice, is to raise the parent's awareness. This article applies to the research topic as well, because to promote the use of technology in early childhood education, parents need to be educated, so parents know how to be influential over their children. Parents need to help maintain a healthy balance of technology and need to support the use as well.

Culture, Diversity, and Technology

When addressing technology in the area of culture and diversity, you often hear about the "digital divide". The term digital divide generally refers to computer access and is based on ethnicity and socioeconomic status. According to the National Institute of Community Innovation (2003), digital equity is a social justice goal of ensuring that all students, regardless of socioeconomic status, physical disability, language, race, or gender, have access to information and communications technologies for learning. The first article in this literature review related on culture, diversity and technology focused on digital equality in early childhood education. In a research study by Judge, Puckett, & Cabuk, (2004) the researchers looked at young children's access to computers in schools and home and conditions that affect how children utilize and experience computers. This study was a descriptive longitudinal study. The sample size was 9840 kindergarten and first grade students, from 669 schools (Judge et al., 2004). Schools were classified by the number of low-income students, which was defined by the number of students who received either free or reduced lunches (Judge et al., 2004). Data was collected from parents of the students, school administrators and teachers. School administrators and the teachers completed a paper questionnaire which focused on the availability of the type of computer resources available to the students (Judge et al., 2004). The school administrators also

provided the number of computers in the school and the number of classrooms that had a variance in the number of computer resources (Judge et al., 2004). Teachers also identified the frequency that students used computers in the classroom as well as what the teachers used them for. Particularly the researchers were interested in whether the students used the computers for educational purposes such as reading, writing, spelling, science, or keyboarding skills, for fun (games), or Internet/Local area network (LAN) access (Judge et al., 2004). Finally, the parents of the students provided information of home computers, the student's access to them and if the students access the intranet (Judge et al., 2004).

The results of this study showed that the digital divide exists, but it is closing. An example of this was that children in the study who attended kindergarten and first grade in public schools had access to at least one computer. Results showing that low-income children have computers in school and have experiences to use the computers to enhance their education, especially around math and reading, indicate that there is indeed a closing of the digital divide (Judge et al., 2004). The results also showed that there is equality around computer access in both low and high poverty school for kindergarteners (Judge et al., 2004). The digital divide gap widens when looking at first graders. "Even though the availability of computer resources at school increased from kindergarten to first grade, higher poverty schools had significantly fewer computers and software programs (Judge et al., 2004)." An interesting finding from this study was that higher poverty schools used computers more for instruction than low poverty schools. While higher poverty schools used computers, more the researchers did not identify the quality of young children's computer use. This is one of the limitations of this study. A second limitation was that there was no indication if the computer resources were available to the students in this study. The questionnaires asked if resources were available in the school but did not state if the resources

were available for kindergarten and first grade students. A final limitation identified by the researchers was that the time span covered young children's access to and use of computer resources from kindergarten in the spring of 1999 to the first grade in the spring of 2000 (Judge et al., 2004). Understanding the disparities among different socioeconomic classes and how to continue to close that gap will promote leveraging technology in early childhood education.

While ethnicity and socioeconomic status are a major factor to the inequality of technology access and use, learning disabilities also contribute to the digital divide. Students with learning disabilities can benefit from the use of technology and computers to enhance their learning and to make it easier for them. Chen, Wang, & Chang, (2014) studied whether a digital divide existed between elementary school aged children with learning disabilities compared to their nondisabled peers. This study looked at 77 males and 40 females with learning disabilities and 77 males and 40 females without learning disabilities. The participants were in the grades third through sixth. The study looked at information and communication technology (ICT) access and ICT competencies. The competencies consisted of 6 skills; “basic computer operation (ten items), word processing (ten items), spreadsheet usage (ten items), presentation software usage (seven items), graphics software usage (four items) and Internet usage (ten items)” (Wu et al., 2014). The results of this study showed that when it came to access to computers and technology there were no significant differences between students with learning disabilities and those who had none (Wu et al., 2014). When it came to the competencies the study showed students with learning disabilities performed lower than those without learning disabilities (Wu et al., 2014). While it was determined that access to computers did not differ, this study did show that just because there were equal opportunities that does not guarantee that everyone is learning necessary skills (Wu et al., 2014).

The researchers did not identify any limitation in the post research analysis. This study applies to the proposed research question as it brings to light that access and opportunities do not equal learning or success. Follow up assessment and validations can inform educators if learning has taken place with the different types of technology introduced to early childhood students.

Culture preferences play an important part in how teachers organize different learning activities in the classrooms which include the use of technology. As educators it is important to address issues of cultural diversity when incorporating technology into the classroom. This study looked at culturally supportive teaching strategies for integrating technology in classrooms. Based on theory and research, Chisholm (1998) identified culturally supportive teaching strategies for the integration of technology in the classroom setting. Chisholm (1998) stated “equitable strategies are those that meet the student’s individual learning needs.” Chisholm (1998) also stated that “culturally responsive teaching connects learning to the child’s real-life experiences and is compatible with the cultural background of learners and their community.” It is important that when working with diverse culture that content is broad enough to reach all students but also has enough detail to make sure the learning is valuable. Chisholm identified six culturally supportive teaching strategies based on research and theory. The first one was culture awareness which is understanding one’s culture and the individual differences and incorporating those differences through learning activities that support different cultures (Chisholm, & Wetzel, 2001). The second one was cultural relevance which is where culturally relevant learning activities are used in the classroom (Chisholm, & Wetzel, 2001). The third teaching strategy was having a culturally supportive environment which are safe and inclusive to the child’s culture family and community (Chisholm, & Wetzel, 2001). The fourth one identified was equitable access which provides the child with access to technology to meet their needs (Chisholm, &

Wetzel, 2001). The fifth strategy was instructional flexibility, which means the educator uses a variety of methods to delivery education based on the individual learners needs (Chisholm, & Wetzel, 2001). The last strategy was instructional integration which is where the educator understands that technology is an essential tool for learning and teaching (Chisholm, & Wetzel, 2001).

Chisholm applied these elements in the evaluation of 32 teacher-generated instructional units that used technology. The researcher found that using these elements proved to clarify how teachers were incorporating computer use in classrooms of diverse environments (Chisholm, 1998). One thing that he identified in his article was that while there is research available on teacher's technology training, perceptions and attitudes, there needs to be further research on the actual use of technology in diverse environments (Chisholm, 1998). This article applies to the research topic because it defines some guiding principles in developing interventions for incorporating technology in early childhood classrooms that are also multicultural.

The next article looked at the use of technology in classrooms with multicultural students. The researcher used a qualitative case study to look at attitudes and motivations of teachers who used technology in their classrooms. The researchers interviewed five female teachers who were early adaptors of smart room technology. The interviews were forty-five minutes, followed by a questionnaire. The reasons five teachers gave for why smart classrooms were chosen to be used, were very similar. One of these reasons was that the physical layout of the Smart Classroom was compatible with the teachers planned activities (Chisholm & Wetzel, 2001). Another common reason was that the layout of the classroom supported the teachers teaching philosophies (Chisholm & Wetzel, 2001). These classrooms were compact which supported the teacher's philosophies that students should have ready access to the computers and the instructor ready

access to the students (Chisholm & Wetzel, 2001). Other similarities included valuing collaborative student work and group sharing (Chisholm & Wetzel, 2001). Chisholm and Wetzel (2001) compared the results of the interviews and questionnaires to see if the six culturally supportive teaching strategies were present. None of the teachers were aware of these six strategies prior to this study. Chisholm and Wetzel (2001) were able to find all six were present, although to varying degrees. The first strategy looked at was providing a culturally supportive environment. The teachers provided environments that supported group work, had collaboration, both a team approach and individual work, students could express their own perspective and the students could incorporate their own experiences (Chisholm & Wetzel, 2001). The second strategy was cultural awareness. According to Chisholm & Wetzel, (2001) the teachers in this study demonstrated cultural awareness by providing individual coaching for non-native English learners. The researchers felt the teachers incorporated cultural relevance by having students self-identify their needs and interests, linking learning to field experiences and connecting personal experiences (Chisholm & Wetzel, 2001). The teachers also created an inclusive classroom environment by encouraging a widespread use of collaboration, group work, and peer help, which fulfilled the teaching strategy of providing a culturally supportive learning environment. These types of environments promote independence and acceptance of student peers. The five teachers in these case studies also provided instructional flexibility which is the fifth strategy (Chisholm & Wetzel, 2001). The teachers offered students choices in their technology learning to coincide with the student's strengths and preferences. Lastly, the teachers in this study used technology for challenging and purposeful reasons. This meets the final strategy which was instructional integration of technology (Chisholm and Wetzel, 2001).

There were no limitations identified in this study by the researchers. The researchers did identify that further research or understanding is needed. Specifically, it was stated “we recommend further study of faculty who choose not to use technology in the classroom to better understand the factors that influence their decisions” (Chisholm and Wetzel, 2001). This study applies to the research question because it presents solid case studies on how to successfully incorporate technology into the classroom.

Literacy is foundational in the early years. Literacy is the foundation for a child’s ability to communicate, socialize, read, and write. Being able to read will help with communication skills and academic success. As educators we know that there are many children at risk for not becoming literate. Culturally and linguistically diverse (CLD) learners from different ethnic backgrounds, such as African, Hispanic, and Native American are often identified at the greatest risk (Musti-Rao et al., 2015). Technology and computer software is an effective way to supplement literacy interventions. Research has shown that teachers who are interested in using technology in their classroom can see many benefits. According to Musti-Rao et al., (2015) some of the benefits of technology use are the teacher’s ability to individualize instruction and have a consistent delivery of instruction. Also identified as benefits were increased motivation of students, active student response and improved classroom management (Musti-Rao et al., 2015). Computer assisted instruction can be used to help improve literacy skills of students with disabilities from culturally diverse and low–socioeconomic status backgrounds, however it is just that, assisted instruction (Musti-Rao et al., 2015). Computer-assisted instruction is a supplemental tool, and research has shown that teacher-led instruction along with reading still needs to occur (Musti-Rao et al., 2015). Musti-Rao et al., (2015) concluded that teachers can use technology to provide supplemental literacy instruction. According to Musti-Rao et al., (2015)

teachers need to know what the target skill is, and then identify an evidence-based strategy, type of technology that is appropriate, a protocol to use and train the students how to use the technology. According to Musti-Rao et al., (2015) to provide supplemental literacy instruction using technology, teachers need to identify the target skill, identify an evidence-based strategy, identify a type of technology that is developmentally appropriate, a protocol to use and train the students on the use of the technology. As Judge et. al, (2004), discussed, there is still inequality in access to computers and technology. For some students, the classroom is the only place a computer is available to be used and since the use of computer-assisted instruction can be a valuable tool in providing supplemental literacy instruction, educators need to make sure students are given time and access to these tools. Musti-Rao et al., 2015 concluded that teachers using computer-assisted technology need to be cognizant of the type of technology they chose to use and that it will be used in ways that will build and strengthen skills of the students.

The article identified how technology can be beneficial for teachers interested in using technology and what teachers need to do to use technology for supplemental literacy instruction. This article relates to the research question because it relates to early childhood education in the form of literacy and support the use of technology as an intervention.

Educator's attitude, perceptions, and barrier

Research has also shown that early childhood educators are not all implementing technology in the classroom related to attitudes, perceptions, and barriers (Blackwell, Lauricella, & Wartella, 2014; Inan & Lowther, 2010, Chen and Chang, 2006; Nikolopoulou & Gialamas, 2013). The first article that was reviewed was by Blackwell, C., Lauricella, A., & Wartella, E., 2014, in which the researchers looked at factors that contribute to early childhood educators' technology use in the classroom (Blackwell, Lauricella, & Wartella, 2014, p.84). Teachers are a

powerful mediator of technology's impact on student learning and supporting them can be a key to the implementation. These participants of this study were 1234 United States Early Childhood educators, working with infants to four-year olds. The teachers were in three different childcare settings, 52% worked in center-based care, 36% in school-based care, and 11% in Head Start centers (Blackwell et al., 2014). Support is shown to have positive direct effects on the use of technology in early childhood education. This study showed that support, technology policy and teaching experience had positive direct effects on technology use. This study showed that if technology is going to be used to aid children's learning in the classroom, then the teachers need support in understanding how to use the technology and help using the technology in the classroom (Blackwell et al., 2014). Previous research has shown that teachers attitudes, and confidence can play a pivotal role in the use of technology in their classroom. This study showed that support also had positive effects on confidence and attitudes. The researchers also identified that teachers with higher confidence and more positive attitudes toward technology are from schools who offer support (Blackwell et al., 2014). These schools also offer support that helps teachers understand how to use technology to improve student learning and have a specific technology vision (Blackwell et al., 2014).

A teacher's personal beliefs around technology will greatly impact how technology is implemented in the classroom. The next study looked at teachers' beliefs about technology. A teachers' belief was defined to be the teachers' perception of the influence of technology on teaching and learning practices. The purpose of the study was to specifically examine the effects of teachers' individual characteristics and environmental factors on teachers' technology integration (Inan & Lowther, 2010). The researchers looked at a teacher's demographic characteristics to see if the demographics influence technology integration (Inan & Lowther,

2010). The researchers also looked at the teacher's beliefs, readiness, and computer proficiency to see if any of those characteristics influence technology integration (Inan & Lowther, 2010). The researchers collected data from teachers employed at 54 schools and had 1382 teachers who completed the two-part questionnaire. The participants identified that almost all had a home computer (93%) and most rated their computer skills as moderate (38.5%) or good (41.8%) (Inan & Lowther, 2010). Through this study the researchers were able to show teachers' readiness, beliefs and computer availability had significant positive effects on computer integration. The researchers also demonstrated that of all the indirect effects found related to support provided to the teachers, which had the strongest effect (Inan & Lowther, 2010). As in other studies, this study supported findings that technology integration is influenced by support. Support is important from peers, administration and even the community when integrating technology in early childhood education.

Children's access to technology is "contingent upon teachers" skills in using and integrating technology (Chen and Chang, 2006, p.170). Attitudes towards and practices with technology in the early childhood classroom are related to teacher training. This current study looked at 297 pre-kindergarten teachers. Of the teachers who participated in the study 98% were female. The teachers' highest education broke down as follows: 4.5% had a high school degree; 19.3% had some college; 17.2% had an AA degree; 33% had a BA degree and 26% had a master's degree (Chen and Chang, 2006). The participants had very minimum courses related to instructional technology. The researchers in this study used a questionnaire that focused on teachers' computer attitudes, knowledge, and practices. The purpose of the study was to understand childhood teachers' attitudes, skills and classroom practices related to the use of computer in their classroom. Results related to attitudes showed that 44.8% felt very confident

using a computer, 47.2% felt comfortable using the internet, while only 50% reported feeling comfortable teaching young children to use computers, 35.3% felt comfortable peers, and 35.3% felt comfortable teaching parents how to use computers (Chen and Chang, 2006). In general, over half of the teachers' survived did not feel comfortable with the use of computers in the classroom. The researchers asked how many in-service training days were received around the use of technology in the last three years. "In response, 48.3% reported participating in one day or less; 32.7% reported 2.5 days; 19% reported participating in more than a week" (Chen and Chang, 2006, p.170). There was a direct correlation to teachers who had more than one week of training and positive results. Teachers who had more than one week of training showed statistically significant positive results. The results showed these teachers rated training as effective in improving computer skills ($p=0.0002$), technology integration ($p=0.0352$) and their computer knowledge and skills ($P=0.0027$) (Chen and Chang, 2006). The researchers of this study recommend that early childhood teacher need additional training for technology (Chen and Chang, 2006). The researchers recommended that schools should "1) make support for classroom implementation a priority; 2) provide more than a week of training; 3) match training to varying levels of teacher confidence skill, and practice" (Chen and Chang, 2006, p.181).

Integrating technology and supporting children's experiences with computer relies heavily on early childhood education teachers. Educators' beliefs, technology skills, and perceived barriers effect how these educators integrated technology into the classrooms. The purpose of this study was to look at what are the barriers to the integration of computers in the early childhood settings. The participants of this study included 134 early childhood teachers in Athens Greece, and were all female (Nikolopoulou & Gialamas, 2013). Half of the classrooms of where the participants worked, only had one computer while one third of these classrooms had

no computers. The method for this research study was a questionnaire comprised of two parts. The first part of the questionnaire collected demographic and individual characteristics, while the second part had 26 question statements aimed to investigate any perceived barriers to the integration of computers in the classroom.

The study showed that early childhood teachers' perceptions of barriers to integrating computers in early childhood settings, were a lack of many things such as funding, technical support, internet access and administrative support (Nikolopoulou & Gialamas, 2013). The studies also identified barriers such as inadequate training opportunities, large number of children in the class and outdated equipment (Nikolopoulou & Gialamas, 2013). The second part of the questionnaire identified four factors that impacted teacher perceptions of barriers, which were lack of support, lack of confidence, lack of equipment and class conditions (Nikolopoulou & Gialamas, 2013). Increasing teachers' confidence is an important take away from this study.

Research findings indicated there is a need for professional development and training to increase teachers' confidence and knowledge of the use of technology (Nikolopoulou & Gialamas, 201). The higher the teachers' confidence the higher the integration of technology in the classroom is.

Conclusion

Research has demonstrated that technology can be used in early childhood education successfully. Research finding have also shown that there are factors that educators need to consider when implementing technology in early childhood education. Research has shown that early childhood educators can use a variety of types of technology to support learning outcomes (Bebell, & Pedulla, 2015; Sullivan and Bers, 2016; Geist, 2012; Van Daal & Reitsma, 2000). Family use and support of technology is another area to consider based on the research reviewed.

Educators need to work with parents and families to ensure there is support in the use of technology in the classroom. Research also showed that educators need to be aware of culture and diversity as it relates to technology in the early childhood environment. Early childhood students will be at different stages of learning based on the technology opportunities received outside the classroom. Lastly, research showed that teacher's perceptions and attitudes can affect the implementation and acceptance of technology in early childhood classrooms. If teachers do not feel supported or comfortable in the ease of technology, there is less of a chance that technology will be used by the teachers (Nikolopoulou & Gialamas, 2013). The research showed that there needs to be a solution to help our early childhood educators increase their confidence in the use of technology in the classroom. One way to increase the educator's confidence is to provide training to these educators.

Chapter Three: Discussion and Future Studies

The research reviewed in this paper, demonstrated that the use of technology can have positive effects on early childhood education as well as children in primary grades (Babell & Pedulla, 2015; Geist, 2012; Sullivan & Bers, 2016; Travers, Higgins, Pierce, Boone, Miller, & Tandy, 2011; Van Daal & Reitsma, 2000). The research also showed that there needs to be a solution to help our early childhood educators increase confidence in the use of technology in the classroom (Chen & Chang, 2006). One way to increase confidence is to provide training to the educators. Research articles support the desire of educators to have training around technology use as well as how to integrate the technology that is developmentally appropriate for the children in the classroom (Chen & Chang, 2006). Early childhood educators need accessible professional development opportunities to become skilled and knowledgeable in making decisions on how to select, use, integrate and evaluate technology use in their classrooms.

Research positively showed that technology can impact cognitive development in early childhood education. Early childhood learners can use technology to do complicated tasks such as programing a robot as early as age five (Sullivan and Bers, 2016). iPads are a specific type of technology that can be used in conjunction with teacher-led instruction to improve math achievement, language arts and literacy skills (Bebell & Pedulla, 2015). Research also demonstrated that two-year-olds were able to interact easily and naturally with a touch screen iPad with little guidance (Geist, 2012). Research demonstrated that two-year-olds were able to work independently with iPads compared to traditional computers (Geist, 2012). Cognitive skills, such as letter knowledge and recognition in kindergartens were shown to significantly improve with computer-assisted education alongside teacher-led instruction (Van Daal & Reitsma, 2000). Technology can also be used with children who have some disabilities such as a reading

disability or autism. Research demonstrated that children with reading disabilities and low levels of motivation can benefit from use of technology. Van Daal & Reitsma, (2000) showed a statistically significant improvement in spelled words pre and post a computer-assisted spelling training for children with reading disabilities.

Children are using technology earlier and earlier and a lot of that is occurring at home. Research showed that three and four-year-old children are able to pick up on technology at home with little help or instruction from parents (Plowman et al., 2008). Parents are the most important influence on a child's use of technology. In a study by Gutnick et al., (2011) it was noted that a parent's guidance with technology can improve a child's learning which has been shown to advance their language development.

Making sure all children have access to technology is important. The presence of the digital divide is slowly closing as evident by the research of Judge et al., (2004). These researchers were able to demonstrate that children in the study who attended kindergarten and first grade in the public schools had access to at least one computer (Judge et al., 2004). It was also demonstrated that low-income children had computers in school and had opportunity to the use of computers to enhance education, especially around math and reading (Judge et al., 2004). Cultural preference is important in how teachers organize different activities with technology. Chisholm (1998), identified that it is important when working with diverse cultures that education content is broad enough to reach all students. Through the research of Chisholm (1998) six culturally supportive teaching strategies were developed.

Early childhood educators' attitudes, beliefs and perceptions of technology will impact how educators chose to implement technology in the classroom. Teachers who feel supported by peers and administration have a greater positive attitude related to implementing technology

(Blackwell et al., 2014; & Inan & Lowther, 2010). Research also demonstrated that a teachers' readiness, beliefs, and computer availability had significant positive effects on computer integration (Inan & Lowther, 2010). Teachers need to have skills and feel confident in the technology if they are going to implement it. There is a gap in the level of training that early childhood educators receive with technology (Chen and Chang, 2006). Research demonstrated that teachers who have more than one week of training with technology, used technology more than teachers who had less training (Chen and Chang, 2006). Chen and Chang, (2006) recommended that early childhood teachers need additional training for technology, which would lead to greater use of technology in the classroom.

Future Research

Technology will continue to change and grow. Educators will continue to use technology as a way to educate children. As the research has shown, one barrier to the implementation of technology in early childhood education can be that of the teacher. A future topic for research would be measuring the teacher pedagogical beliefs and any correlations to the use of technology in the classroom. Is there a direct correlation between the use of technology in the classroom to a pedagogical belief of teacher-centered learning or student-centered learning? Because the use of technology in early childhood education is new, an additional topic for future research would be a research study exploring longitudinal data over time to provide casual results. A longitudinal study in this case would have different cohorts, and the cohorts would be studied from early childhood education through college to better understand the impact of technology on the children. This type of study would be randomized experimental as some cohorts would use technology while the others would not. The body of existing research around the integration of technology in early childhood education is small. This review included research that included

school aged (greater than five) children and schoolteachers. Future research could be done to look at early childhood teachers, as there are many differences between a childhood teacher and a schoolteacher. One difference that future research could focus on is the teacher's education background, degree, or no degree, and how that impacts the implementation of technology in early childhood education.

Conclusion

Children are using technology at earlier and earlier ages and educators can tap into a child's skills in using technology devices to augment what is being taught in the classroom. Having an understanding and learning the types of technology that can be used in early childhood education will allow educators to tap into young children's potential learnings. Knowing which types of technology have been shown to have positive outcomes on early childhood education will help educators find developmentally appropriate technology for the learning environments. Finding new and exciting ways to incorporate technology into early childhood education will continue to be important, especially as technology continues to grow.

The research in this literature review has shown that there are perceived barriers to integrating technology in the classrooms. Early childhood teachers need additional training for technology to improve technology skills (Chen & Chang, 2006). Knowing that technology can have positive impacts of cognitive development, it will be important to provide these educators with the knowledge and skills needed. Closing the gap in support for early childhood educators when it comes to integrating technology into the classroom, is another barrier that needs to be addressed (Blackwell et al., 2014; & Inan & Lowther, 2010). There will always be a need for continuous professional development opportunities to continue building knowledge in the use of technology in early childhood education (Chen & Chang, 2006). Technology is constantly

changing and changing at a very rapid pace. Children are also using technology at younger and younger ages (Plowman et al., 2011). If there is an expectation that early childhood educators are to integrate technology and use it appropriately based on developmental skills, there will need to be continuous professional development to keep up with all the changes in technology and the best practices for its use (Chen and Chang, 2006). Offering educational opportunities and providing support to our educators will be the key to removing some of these barriers (Chen & Chang, 2006). With our educators feeling empowered and confident in the use of technology, schools should start to see the benefits to the children as technology is integrated into early childhood education.

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